Important Stress Formulas PDF

Formulas
Examples
with Units

List of 22
Important Stress Formulas

1) Area of Inclined Plane given Stress Formula

Evaluate Formula

Formula

$$a_i = \frac{P_t \cdot (\cos(\theta))^2}{\sigma_i}$$

Example with Units

$$799.9916\,\text{mm}^2 = \frac{59611\,\text{N} \cdot (\cos(35°))^2}{50.0\,\text{MPa}}$$

2) Beam Shear Stress Formula

Evaluate Formula

Formula

$$\zeta_b = \frac{\Sigma S \cdot Ay}{I \cdot t}$$

Example with Units

$$27.4286\,\text{Pa} = \frac{320\,\text{N} \cdot 4500\,\text{mm}^3}{3.5\,\text{kg·m}^2 \cdot 0.015\,\text{mm}}$$

3) Bending Stress Formula

Evaluate Formula

Formula

$$\sigma_b = M_b \cdot \frac{y}{I}$$

Example with Units

$$6.5\text{E-}5\,\text{MPa} = 450\,\text{N*m} \cdot \frac{503\,\text{mm}}{3.5\,\text{kg·m}^2}$$

4) Brinell Hardness Number Formula

Evaluate Formula

Formula

$$BHN = \frac{W}{(0.5 \cdot \pi \cdot D) \cdot \left(D - \left(D^2 - d_i^2\right)^{0.5}\right)}$$

Example with Units

$$3208.1335 = \frac{3.6\,\text{N}}{(0.5 \cdot 3.1416 \cdot 62\,\text{mm}) \cdot \left(62\,\text{mm} - \left(62\,\text{mm}^2 - 36\,\text{mm}^2\right)^{0.5}\right)}$$

5) Bulk Stress Formula

Evaluate Formula

Formula

$$B_{stress} = \frac{N.F}{A_{cs}}$$

Example with Units

$$0.0176\,\text{MPa} = \frac{23.45\,\text{N}}{1333.4\,\text{mm}^2}$$

6) Direct Stress Formula

Evaluate Formula

Formula

$$\sigma = \frac{P_{axial}}{A_{cs}}$$

Example with Units

$$1748.9126\,\text{Pa} = \frac{2.332\,\text{N}}{1333.4\,\text{mm}^2}$$

7) Load of Inclined Plane given Stress Formula

Evaluate Formula

Formula

$$P_t = \frac{\sigma_i \cdot A_i}{\left(\cos\left(\theta\right)\right)^2}$$

Example with Units

$$59611.6239\,\text{N} = \frac{50.0\,\text{MPa} \cdot 800\,\text{mm}^2}{\left(\cos\left(35^\circ\right)\right)^2}$$

8) Maximum Principal Stress Formula

Evaluate Formula

Formula

$$\sigma_{max} = \frac{\sigma_x + \sigma_y}{2} + \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \zeta_{xy}^2}$$

Example with Units

$$96.0555\,\text{MPa} = \frac{80\,\text{MPa} + 40\,\text{MPa}}{2} + \sqrt{\left(\frac{80\,\text{MPa} - 40\,\text{MPa}}{2}\right)^2 + 30\,\text{MPa}^2}$$

9) Maximum Shearing Stress Formula

Evaluate Formula

Formula

$$\sigma_1 = \frac{1.5 \cdot V}{A_{cs}}$$

Example with Units

$$47247.6376\,\text{Pa} = \frac{1.5 \cdot 42\,\text{N}}{1333.4\,\text{mm}^2}$$

10) Minimum Principal Stress Formula

Evaluate Formula

Formula

$$\sigma_{min} = \frac{\sigma_x + \sigma_y}{2} - \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \zeta_{xy}^2}$$

Example with Units

$$23.9445\,\text{MPa} = \frac{80\,\text{MPa} + 40\,\text{MPa}}{2} - \sqrt{\left(\frac{80\,\text{MPa} - 40\,\text{MPa}}{2}\right)^2 + 30\,\text{MPa}^2}$$

11) Shear Stress Formula

Evaluate Formula

Formula

$$\tau = \frac{F_t}{A_{cs}}$$

Example with Units

$$18.7491\,\text{Pa} = \frac{0.025\,\text{N}}{1333.4\,\text{mm}^2}$$

12) Shear Stress in Double Parallel Fillet Weld Formula

Evaluate Formula

Formula

$$\zeta_{fw} = \frac{P_{dp}}{0.707 \cdot L \cdot h_l}$$

Example with Units

$$188.1797\,\text{Pa} = \frac{0.55\,\text{N}}{0.707 \cdot 195\,\text{mm} \cdot 21.2\,\text{mm}}$$

13) Shear Stress of Circular Beam Formula

Evaluate Formula

Formula

$$\sigma_1 = \frac{4 \cdot V}{3 \cdot A_{cs}}$$

Example with Units

$$41997.9001\,\text{Pa} = \frac{4 \cdot 42\,\text{N}}{3 \cdot 1333.4\,\text{mm}^2}$$

14) Shear Stress on Inclined Plane Formula

Evaluate Formula

Formula

$$\zeta_i = -P_t \cdot \sin(\theta) \cdot \frac{\cos(\theta)}{A_i}$$

Example with Units

$$-35.01\,\text{MPa} = -59611\,\text{N} \cdot \sin(35°) \cdot \frac{\cos(35°)}{800\,\text{mm}^2}$$

15) Shearing Stress Formula

Evaluate Formula

Formula

$$\tau = \frac{V \cdot Ay}{I \cdot t}$$

Example with Units

$$3.6\,\text{Pa} = \frac{42\,\text{N} \cdot 4500\,\text{mm}^3}{3.5\,\text{kg·m}^2 \cdot 0.015\,\text{mm}}$$

16) Stress due to Gradual Loading Formula

Evaluate Formula

Formula

$$\sigma_g = \frac{F}{A_{cs}}$$

Example with Units

$$19401.5299\,\text{Pa} = \frac{25.87\,\text{N}}{1333.4\,\text{mm}^2}$$

17) Stress due to Impact Loading Formula

Evaluate Formula

Formula

$$\sigma_l = W_{load} \cdot \frac{1 + \sqrt{1 + \frac{2 \cdot A_{cs} \cdot \sigma_b \cdot h}{W_{load} \cdot L}}}{A_{cs}}$$

Example with Units

$$93544.2481\,\text{Pa} = 53\,\text{N} \cdot \frac{1 + \sqrt{1 + \frac{2 \cdot 1333.4\,\text{mm}^2 \cdot 0.00006447\,\text{MPa} \cdot 50000\,\text{mm}}{53\,\text{N} \cdot 195\,\text{mm}}}}{1333.4\,\text{mm}^2}$$

18) Stress due to Sudden Loading Formula

Evaluate Formula

Formula

$$\sigma_1 = 2 \cdot \frac{F}{A_{cs}}$$

Example with Units

$$38803.0598\,\text{Pa} = 2 \cdot \frac{25.87\,\text{N}}{1333.4\,\text{mm}^2}$$

19) Stress on Inclined Plane Formula

Evaluate Formula

Formula

$$\sigma_i = \frac{P_t \cdot \left(\cos\left(\theta\right)\right)^2}{A_i}$$

Example with Units

$$49.9995\,\text{MPa} = \frac{59611\,\text{N} \cdot \left(\cos\left(35°\right)\right)^2}{800\,\text{mm}^2}$$

20) Thermal Stress Formula

Evaluate Formula

Formula

$$\sigma_T = \alpha \cdot \sigma_b \cdot \Delta T$$

Example with Units

$$22.3389\,\text{Pa} = 0.005 \cdot 0.00006447\,\text{MPa} \cdot 69.3\,\text{K}$$

21) Thermal Stress in Tapered Bar Formula

Evaluate Formula

Formula

$$\sigma_T = \frac{4 \cdot W_{load} \cdot L}{\pi \cdot D_1 \cdot D_2 \cdot \sigma_b}$$

Example with Units

$$23.452\,\text{Pa} = \frac{4 \cdot 53\,\text{N} \cdot 195\,\text{mm}}{3.1416 \cdot 172.89\,\text{mm} \cdot 50.34\,\text{mm} \cdot 0.00006447\,\text{MPa}}$$

22) Torsional Shear Stress Formula

Evaluate Formula

Formula

$$\tau = \frac{\tau \cdot r_{shaft}}{J}$$

Example with Units

$$20.5166\,\text{Pa} = \frac{556\,\text{N*m} \cdot 2000\,\text{mm}}{54.2\,\text{m}^4}$$

Variables used in list of Stress Formulas above

- ΔT Change in Temperature *(Kelvin)*
- A_{cs} Cross Sectional Area *(Square Millimeter)*
- a_i Area of Inclined Plane given Stress *(Square Millimeter)*
- A_i Area of Inclined Plane *(Square Millimeter)*
- **Ay** First Moment of Area *(Cubic Millimeter)*
- B_{stress} Bulk Stress *(Megapascal)*
- **BHN** Brinell Hardness Number
- **D** Diameter of Ball Indenter *(Millimeter)*
- D_1 Diameter of Bigger End *(Millimeter)*
- D_2 Diameter of Smaller End *(Millimeter)*
- d_i Diameter of Indentation *(Millimeter)*
- **F** Force *(Newton)*
- F_t Tangential Force *(Newton)*
- **h** Height at which Load Falls *(Millimeter)*
- h_l Leg of Weld *(Millimeter)*
- **I** Moment of Inertia *(Kilogram Square Meter)*
- **J** Polar Moment of Inertia *(Meter⁴)*
- **L** Length of Weld *(Millimeter)*
- M_b Bending Moment *(Newton Meter)*
- **N.F** Normal Inward Force *(Newton)*
- P_{axial} Axial Thrust *(Newton)*
- P_{dp} Load on Double Parallel Fillet Weld *(Newton)*
- P_t Tensile Load *(Newton)*
- r_{shaft} Radius of Shaft *(Millimeter)*
- **t** Thickness of Material *(Millimeter)*
- **V** Shearing Force *(Newton)*
- **W** Load *(Newton)*
- W_{load} Weight of Load *(Newton)*
- **y** Distance from Neutral Axis *(Millimeter)*
- ζ_b Beam Shear Stress *(Pascal)*
- ζ_{fw} Shear Stress in Double Parallel Fillet Weld *(Pascal)*

Constants, Functions, Measurements used in list of Stress Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- Functions: **cos**, cos(Angle) *Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.*
- Functions: **sin**, sin(Angle) *Sine is a trigonometric function that describes the ratio of the length of the opposite side of a right triangle to the length of the hypotenuse.*
- Functions: **sqrt**, sqrt(Number) *A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.*
- Measurement: **Length** in Millimeter (mm) *Length Unit Conversion*
- Measurement: **Area** in Square Millimeter (mm²) *Area Unit Conversion*
- Measurement: **Pressure** in Megapascal (MPa) *Pressure Unit Conversion*
- Measurement: **Force** in Newton (N) *Force Unit Conversion*
- Measurement: **Angle** in Degree (°) *Angle Unit Conversion*
- Measurement: **Temperature Difference** in Kelvin (K) *Temperature Difference Unit Conversion*
- Measurement: **Torque** in Newton Meter (N*m) *Torque Unit Conversion*
- Measurement: **Moment of Inertia** in Kilogram Square Meter (kg·m²) *Moment of Inertia Unit Conversion*
- Measurement: **Moment of Force** in Newton Meter (N*m) *Moment of Force Unit Conversion*
- Measurement: **Second Moment of Area** in Meter⁴ (m⁴) *Second Moment of Area Unit Conversion*
- Measurement: **First Moment of Area** in Cubic Millimeter (mm³)

- ζ_i Shear Stress on Inclined Plane *(Megapascal)*
- ζ_{xy} Shear Stress acting in xy Plane *(Megapascal)*
- θ Theta *(Degree)*
- σ Direct Stress *(Pascal)*
- σ_1 Stress on Body *(Pascal)*
- σ_b Bending Stress *(Megapascal)*
- σ_g Stress due to Gradual Loading *(Pascal)*
- σ_i Stress on Inclined Plane *(Megapascal)*
- σ_l Stress due to Loading *(Pascal)*
- σ_{max} Maximum Principal Stress *(Megapascal)*
- σ_{min} Minimum Principal Stress *(Megapascal)*
- σ_T Thermal Stress *(Pascal)*
- σ_x Normal Stress along x Direction *(Megapascal)*
- σ_y Normal Stress along y Direction *(Megapascal)*
- ΣS Total Shear Force *(Newton)*
- τ Torque *(Newton Meter)*
- α Coefficient of Thermal Expansion
- τ Shearing Stress *(Pascal)*

First Moment of Area Unit Conversion

- Measurement: **Stress** in Pascal (Pa)
Stress Unit Conversion

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